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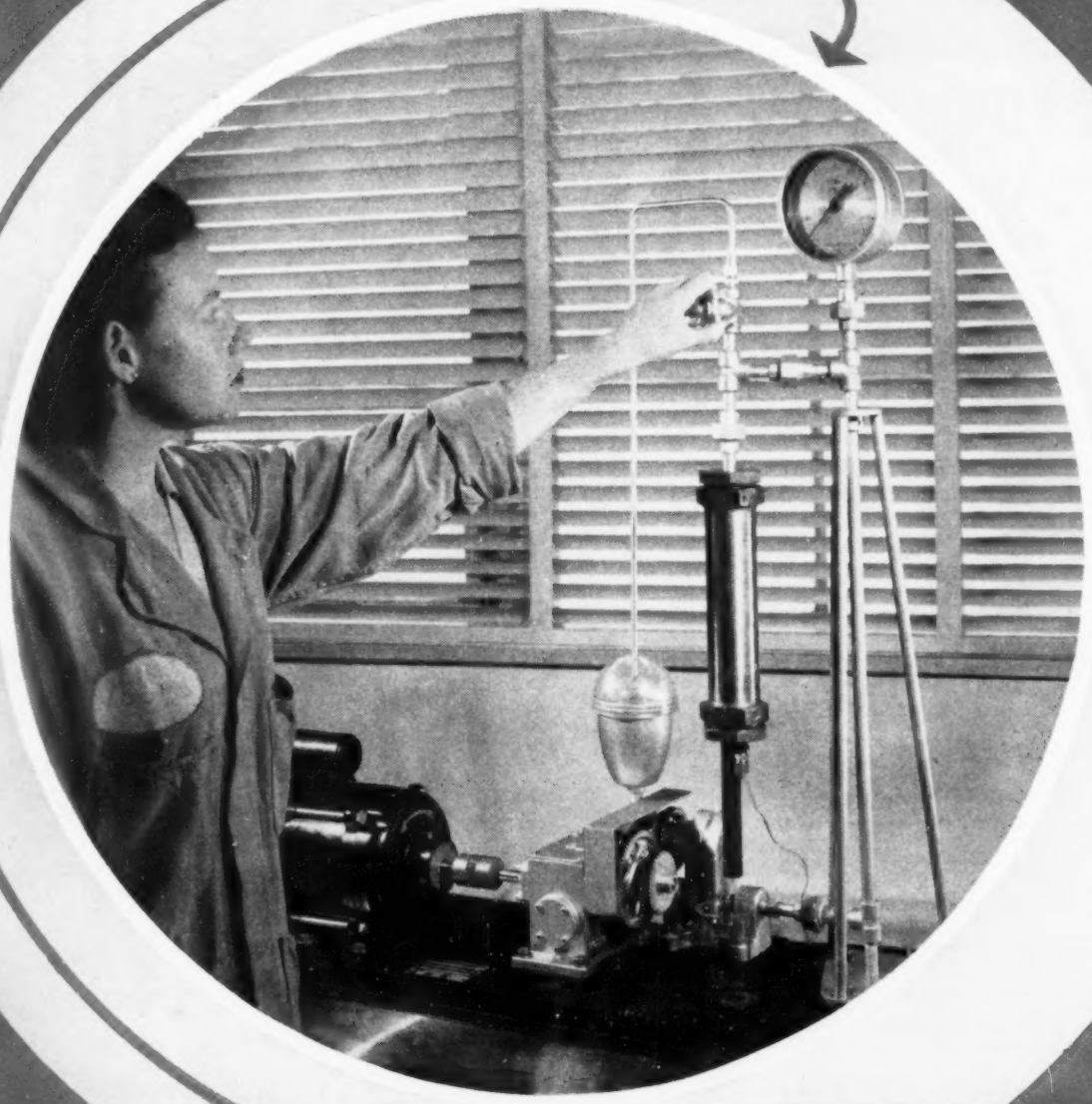


"THE S.O.D. PRESSURE VISCOSIMETER"

PUBLISHED BY THE
NATIONAL LUBRICATING GREASE INSTITUTE

VOLUME XI • NUMBER 9 • DECEMBER 1947

"PRECISION" - S·O·D

PRESSURE VISCOSIMETER

New, simplified, constant flow device for determining viscosity of grease

The "Precision" S.O.D. Pressure Viscosimeter is designed for simplicity and flexibility in making viscosity measurements of greases. Repeated field and research tests have established these measurements as invaluable in comparing greases and predicting performance. The flow rate and range of shear rates developed with the new S.O.D. Viscosimeter are suitable for a wide variety of lubricating greases. Although built for ordinary temperature tests, the apparatus can also be modified for low temperature applications as well as tests up to 375° F.

In this apparatus, the grease sample is forced through a suitable capillary by displacement from a cylinder. Mineral oil, used as the displacing hydraulic medium, is pressed against the surface of the cylinder piston by a constant-volume, gear-driven metering pump. For pressure reading, a Bourdon type pressure gauge is placed in the oil circuit . . . or for very low pressures, a mercury manometer. The metering pump is operated by a ¼ H. P. motor through a geared, constant-speed reducer.

The S.O.D. Pressure Viscosimeter, completely assembled on a heavy metal base, includes the following . . .

(1) Three identical grease chambers to facilitate preparation of samples.

(2) Four Bourdon tube test gauges with the following ranges: 0-50 lbs.; 0-100 lbs.; 0-500 lbs.; 0-2000 lbs.

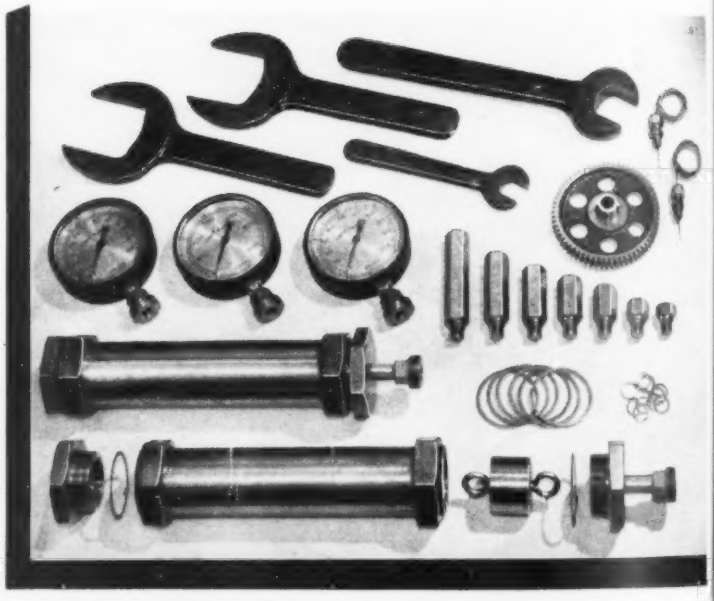
(3) Eight interchangeable capillaries, 40:1, each with a male thread and copper gasket for leak-proof attachment to grease chamber, make it possible to obtain a shear curve through out a pressure range from 0 to 1500 lbs. per spuare inch.

(4) Three thermocouples of No. 25 B. & S. Gauge copper constantan wire.

(5) Extra gear enables extension of shear rate by installation in the gear train between the speed reducer and the metering pump.

(6) Set of wrenches, required for interchanging gauges, grease chambers, capillaries, gears, and thermocouples.

(7) Strainer system for hydraulic oil, consisting of oil cup with removable strainer, transparent plastic cover, and needle valve in return line, to permit bleeding the hydraulic system of air prior to test.



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About the Front Cover

Have you noticed the picture of the O.D. Pressure Viscosimeter on the front ver of this issue of "The Institute okesman"? This is the first of a series pictures that will show various pieces grease testing apparatus. Each month different picture will be used, each onth this column will carry a brief scription and an outline of the operan of the piece of grease testing apparas that is pictured. To insure the acracy of this descriptive material, the tement will be approved by the Chairan and Vice Chairmen of the N.L.G.I. chnical Committee.

This is sure to be a very popular series pictures for the front cover of "The stitute Spokesman" because every one the Industry and all of the readers of The Institute Spokesman" are interted in grease testing and the various ces of apparatus that are used for this purpose. Proper credit and acknowledgment must be given to one of the Associate Members of the N.L.G.I., the Precision Scientific Company, 3737 Cortland St., Chicago 34, Illinois, for having provided these pictures. With the splendid cooperation of Mr. Alexander I. Newman, Mr. J. Duray, who is a member of the N.L.G.I. Technical Committee and Mr. J. A. Marsden, these pictures, specially posed and photographed for "The Institute Spokesman" have been made available.

A month by month schedule has already been set up for this series of grease testing apparatus pictures and if any of you readers are interested in having advance information about which piece of apparatus will be pictured during the next several months, this office will be glad to give you the schedule.

he S.O.D. Pressure iscosimeter

Pictured on the front cover of this issue.

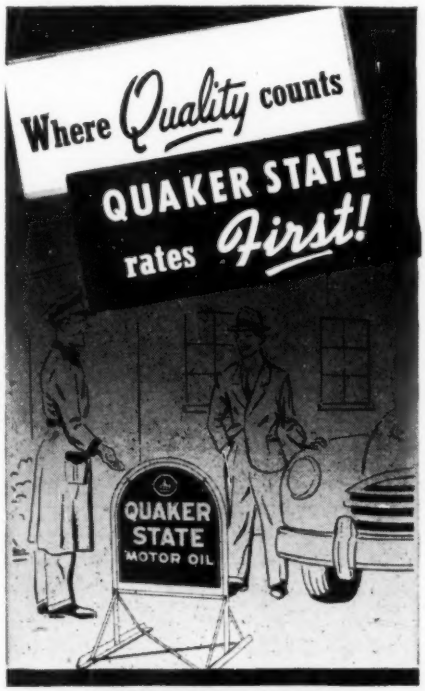
The S.O.D. Pressure Viscosimeter is signed to measure the apparent viscosi- of greases at various fixed rates of ear. This apparatus is designed for dinary temperature tests, but it can modified for low temperature applitions, as well as tests at elevated mperatures. The range of flow and nge of shear rates developed with the ssure Viscosimeter have been found itable for a wide variety of lubricating eases.

Essentially, the S.O.D. Pressure Viscoseter consists of a capillary through ich grease is forced from a cylinder, hydraulic pressure. The grease samay be loaded into the cylinder by ction, which assures the absence of bubbles or pockets in the test sample. ¼ h.p. motor, equipped with gear ucer, drives a pump which forces the draulic medium (mineral oil) against iston which displaces the grease from cylinder, through the capillary.

The grease is forced through the capil- until equilibrium pressure is obned. Calculation of apparent viscosi- is made using this final pressure in seuille's equation.

* * *

complete report on the S.O.D. Pressure Vismeter, entitled "Determination of the Flow Characteristics of Lubricating Greases", Summary Report Project C.L.L.G.-20-43, has been published by the Technical Committee of the National Lubricating Grease Institute, and is available at $1.00 per copy from the N.L.G.I., 4638 Mill Creek Pkwy., Kansas City 2, Mo.



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SOME TEST EQUIPMENT for GREASES

• by R. J. S. PIGOTT, Chief Engineer
Gulf Research & Development Company

Presented at National Lubricating Grease Institute Annual Convention, Chicago, Illinois, October 16-18, 1947

About the Author

Mr. R. J. S. Pigott is a man of long experience in power plant engineering and research work and is widely known in these fields.

He is President-elect of the Society of Automotive Engineers.

He was graduated from Columbia University in 1906 with Degree of Mechanical Engineering.

He entered the central station business and was engaged for several years in the installation of low pressure turbines and other power plant equipment, and in reconstructing several electric light plants in the east and middle west.

For one year he was Professor of Steam Engineering at Columbia University.

From 1915 to 1920 he was Consulting Engineer and engaged in the construction of power and service equipment for Remington Arms.

He became Superintendent of Mills of the Bridgeport Brass Company and later Works Manager of the Crosby Steam Gage & Valve Company, introducing new designs of safety valves and steam gages and similar equipment.

In 1922 he became a Mechanical Engineer at Stevens & Wood and later designed and constructed large power plants for Public Service Production Company.

In 1929 he joined the Gulf Research & Development Company where he is Chief Engineer in charge of Engineering Research for Gulf Oil Corp. and its subsidiaries.

He is an inventor, having received about 30 patents relative to power plant equipment, oil burners, meters, test equipment and pumps.

From 1916 to 1946 he served as Chairman of the Special Research Committee on Fluid Meters of A.S.M.E.

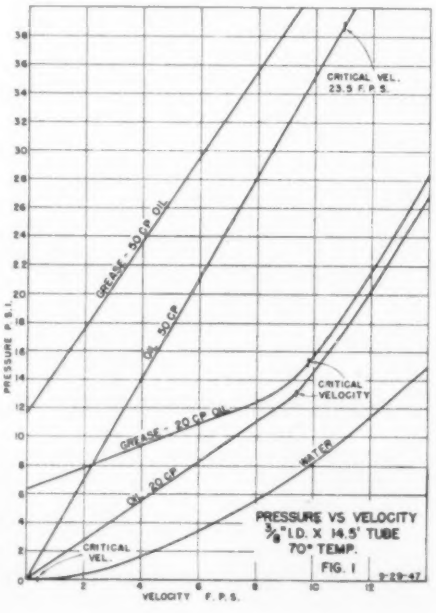
From 1918 to 1946 he served as a member of Main Power Test Codes Committee of A.S.M.E.

He was the first President of the former American Society for Measurement and Control, now the Pittsburgh Chapter of the Instrument Society of America.

He is the author of about 40 papers on power plant design, fluid flow, instruments, lubrication, fuel and lubrication systems in aviation, and on superchargers.

R. J. S. Pigott,
Chief Engineer
Gulf Research & Development Company

The peculiar nature of greases introduces some complications in the asbolute determination of behavior in a bearing. The reason is, of course, that greases — even fluid greases — are not true or Newtonian liquids but have plasticity as well as viscosity. It follows that t relatively simple hydraulic relations b tween viscosity, density, velocity, dia eter and length of passage, do not ap to grease. It will be shown, howev that where expressions are developed f the variation of viscosity with rate shear (or speed of flow in any giv passage), the hydraulic formulae can employed by introducing the expres for variation of viscosity with rate shear, or its first power relation, veloc



We have needed such formulation a long time for the following purpos

1. Flow in greasing equipment w pressure
2. Flow in bearings, associated w change of apparent viscosity heating and to get load-carryi capacity
3. Friction in rolling bearings, a co plicated matter.

To remind us of the differences tween liquids, plastics, muds and gre Fig. 1 is plotted in ordinary Cartesian ordinates. This plot shows the differe between true liquids, such as water oil, and those materials that have b plasticity and a viscosity, such as m and greases.

Some years ago the writer mad study on the flow of muds, which used in oil well drilling for bringing cuttings. The properties of these m as to flow characteristics and suspen of cuttings had never received m scientific study and considerable trou was experienced in drilling with inad to predict mud pump pressures requ to get proper circulation rates down 10,000 ft. of drill pipe and up the h It was found that sufficient exp ments had been made as early as 192 which gave all the clues necessary formulate the variation of mud f with pressure in any conduit syst This study,[2] published in 1941, sho that by obtaining the apparent visco of mud with rate of shear, (or for given system, velocity of flow,) ordinary hydraulic formulae would se for calculation of flow by the use

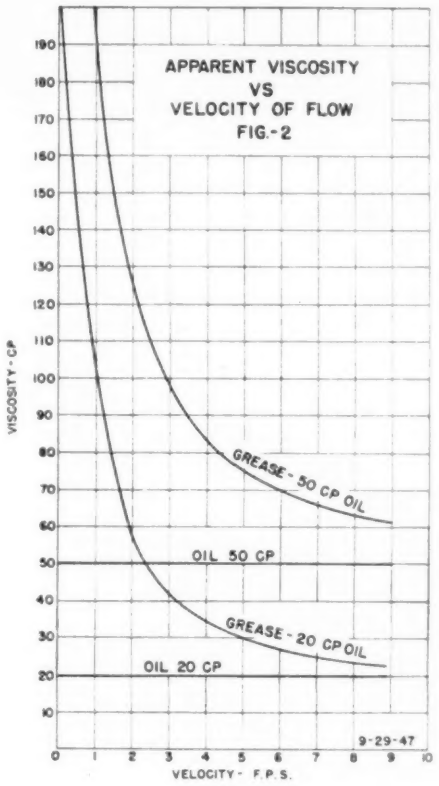
1. The Pumping of Clay Slurries, W. B. Ze ASME Trans. 49, (1927).
2. Mud Flow in Drilling, R. J. S. Pigott, API 1941.

variable apparent viscosity in place of the usual constant viscosity of a true fluid.

Referring again to Fig. 1, the two regimes of flow, viscous and turbulent, show up. On water, in this particular system, viscous flow ceases at about 0.4 f.p.s. and the whole of the rest of the curve is in turbulent flow. For the lighter oil and the greases made with it, the change occurs around 9 to 10 f.p.s.; while for the heavier oil and grease, the change-over does not take place until 20 or 24 f.p.s., beyond the range of Fig. 1.

With greases, as a rule, we are concerned chiefly with viscous flow, as the conditions under which the grease is employed do not often reach up to the turbulent region. But the comparison of the lighter greases with the muds investigated earlier, was necessary to establish that the same general laws of flow would subsist for both greases and muds, especially those muds made with gelling materials like Bentonite.

During the war this laboratory carried on a considerable program of fuel and lubricant pump testing for the aviation industry, down to conditions of chill where the oil became, so to speak, a



grease. The results of much of this work were published in ASME and SAE papers. [3, 4, 5] These studies show conclusively that the losses in any pump or line can be calculated quite accurately for any material to be pumped, from a single series of tests on one liquid, say an oil. If we have the kind of information given in Fig. 1, from which apparent viscosity is obtainable by the Poiseulle type of flow, equation $p = \frac{.00691\ \mu l v}{d^2}$, we can easily predict, from pump suction side dimensions and a loss test on the pump, under what conditions the pump will begin to cavitate, and what it will deliver in the cavitation region. This calculation can eliminate the necessity for so-called pumpability tests.

We can also calculate the resistance from a grease gun to a supply system, of use in determining what effective pressure can be made available at the grease fitting. It is quite probable that

3. Oil Aeration, R. J. S. Pigott, SAE Journal, 52, March, 1944.
4. Vapor Lock, or Dumb Engineering, R. J. S. Pigott, SAE Journal, 52, July, 1944.
5. Some Characteristics of Rotary Pumps in Aviation Service, R. J. S. Pigott, ASME Trans. 66, October, 1944.

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the torque resistance in a ball or roller bearing can be predicted by the apparent viscosity, but there is need for some correlative test work before the necessary data can be fixed. In a ball or roller bearing, three kinds of resistance to rotation occur: high load, low velocity slip between ball and race; viscous shear between ball and cage; and turbulent agitation, balls and cage moving past or through a body of grease. It is likely that a full solution of this problem by calculation may be too laborious, and that a shorter method would be to run tests on two or three greases, or previously measured apparent viscosities, setting up a range; then other greases can be located in this range by comparison of their viscosity curves with those of the tested greases.

Another matter which affects this situation is the change of consistency with amount of working. We are interested in unworked consistency for initial starts and in worked consistency for all operating conditions. It is evident that a suitable instrument for apparent viscosity must also be able to determine the amount of working in absolute units as well. This is in order to present "life history" of the grease in working, and whether or not it recovers unworked consistency after a period of rest.

The penetrometers and consistometers generally used are quite useful for comparing one grease relative to another, consequently allow inferences as to behavior; but none of these, needle, cone, or ball type, give an absolute measurement of anything, so that the values cannot be employed in any formulation. Only one instrument now in commercial use can do so, i.e., the S.O.D. pressure viscometer. This instrument is open to two possible objections. The first is that the pressure measurement is not confined to the capillary tube, but includes the resistance to flow in the larger main chamber at a different rate of shear and a piston friction. An unknown error is therefore present. While tests with no grease tend to show this error not exceeding 2%, our experience with piston type pressure gages indicates that a piston usually has quite different friction under load than when operated free and the friction changes in use; we do not feel that the unloaded tests for losses external to the capillary tube are reliable.

The second objection is that the machine is once-through flow, and the grease cannot be worked without removal from the viscometer.

In the instrument developed at the Gulf laboratory, both these objections are wiped out. The device consists of a double acting cylinder, shown in Figs. 3 and 4, hydraulic drive. The grease is placed in the cylinder by a method which gives no appreciable working and eliminates air. The grease can then be flowed through the capillary from one end of the cylinder to the other, in one direction; then by reversing the stroke can be flowed through the capillary in the reverse direction.

Since the stroke is a definite length

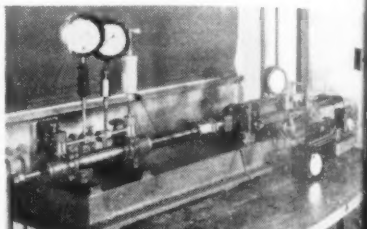

Figure 3
Gulf Pressure Viscometer

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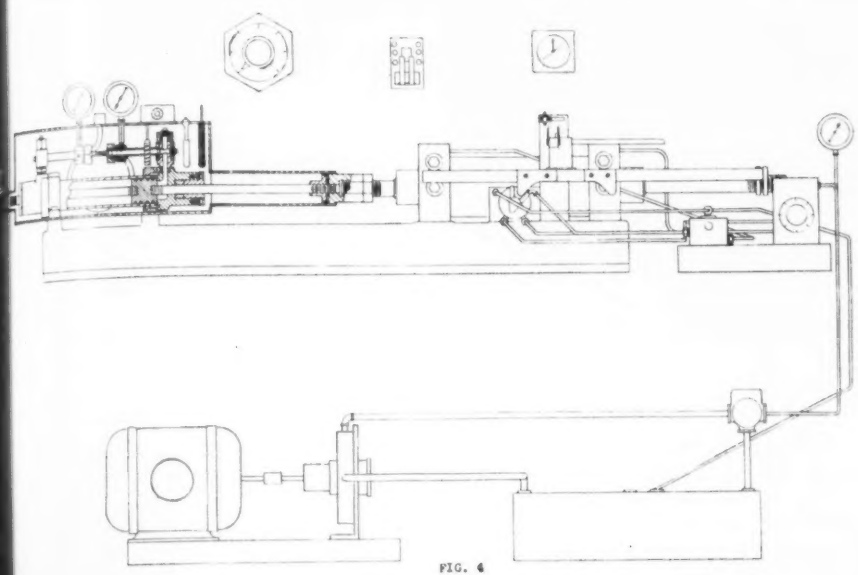

FIG. 4

PRESSURE VISCOMETER

d the pressure gages read the drop oss the capillary alone by means of phragms, the work done on the grease exactly determined. The speed of mo- n is controlled constant at the driv- cylinder, and can be set to any value different rates of shear. Fig. 5 shows e results obtained on one grease at con- stant shear rate. Curve 1 shows the first test, evaluating the decrease of apparent viscosity, from unworked condition to the stabilization at 150,000 in. lb./lb. work. A rest of approximately 20 hours, curve 2, showed the grease recovering its unworked properties, but the rate of decline to stable viscosity is

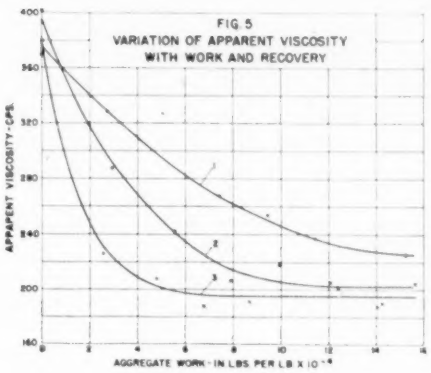

FIG. 5
VARIATION OF APPARENT VISCOSITY WITH WORK AND RECOVERY

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shorter, 110,000 in lb./lb. Another rest of 20 hours, curve 3, produced a second recovery and still faster decline to stable viscosity 70,000 in. lb. In each case, the grease showed a decrease of stabilized viscosity, which finally ceases at a value above that for the oil alone.

Since the capillary tube and work cylinder are jacketed in oil, the rise of temperature due to work in the capillary tube is substantially eliminated and the measurement is definitely at constant temperature.

The variation of viscosity with rate of shear can be easily obtained by running a series of tests at different stroke speeds. The capillaries can also be changed to allow different ranges, if necessary. In this way both variation with working and with rate of shear are obtained.

It is of course possible to get the same viscosity measurement with absolute viscometers of the modified McMichael type used by Ambrose and Loomis [6], but the difficulty with these is that continuous readings must be taken and there is somewhat greater difficulty in cooling

6. Fluidities of Thixotropic Gels: Bentonite Suspensions. H.A. Ambrose and A. G. Loomis, Physics 4(8), 267, 1933.

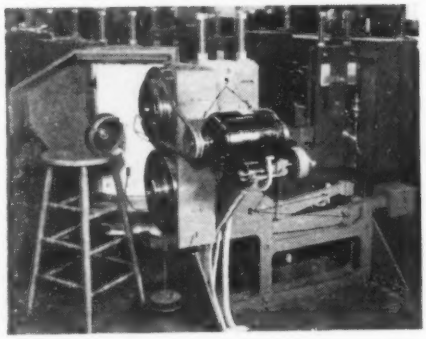

Figure 6
Grease Evaluation Machine

the coaxial surfaces so that the grease is really held to constant temperature.

The B.E.C. machine is useful for determining the mechanical behavior of a grease, such as retention, stability, channeling, etc., but it can tell little about how the grease is *lubricating* the bearing because the bearing is not loaded. The wheel-bearing type tester developed cooperatively through C.R.C. is also open to the same objection.

Our own type of bearing tester was first in operation in 1938; six have been in operation for the last six or seven years. We have had approximately 100,000 hours of testing.

It is our firm conviction that the success of any lubricant is not assured until it has been run in a loaded bearing.

Fig. 6 shows the assembly with the constant temperature hood open. Fig. shows disassembly showing heating elements and parts. Fig. 8 shows the bearing mounts.

In Fig. 6. the loading system that forces the drums against each other shows at [1] and [2]. Since the barrier in spacer [6], Fig. 8, prevent migration of grease, four independent tests can be carried on simultaneously in this machine.

It is obvious from the construction that speed, load and temperature can

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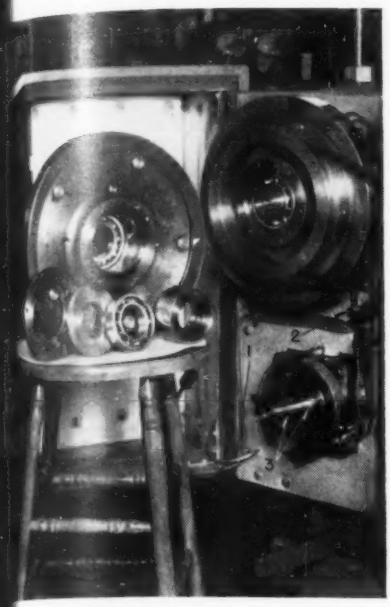

FIG. 7
Grease Evaluation Machine Showing Assembly Parts

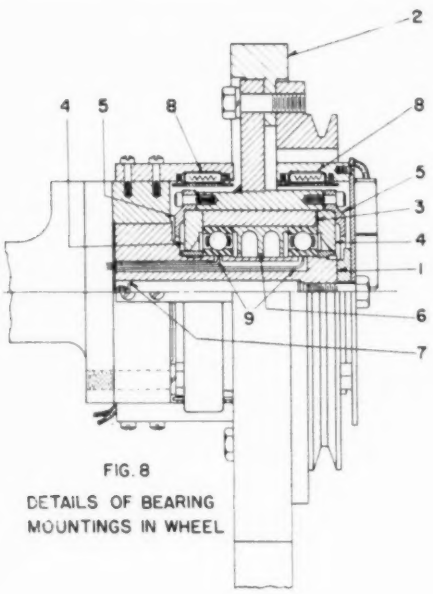

FIG. 8
DETAILS OF BEARING MOUNTINGS IN WHEEL

be varied, and also controlled. The device takes a size 210 bearing and after some years of experience we find great care is necessary in finish and working clearance, to get reproducible results. Carelessness in fits or normal clearance in the bearing will result in testing the bearing to failure instead of the grease. As originally built, these machines used Ford and Chevrolet front axle studs, but we soon found that it is impracticable to permit manual adjustment of clearance. This situation ruled out tapered roller bearings and angular ball contact

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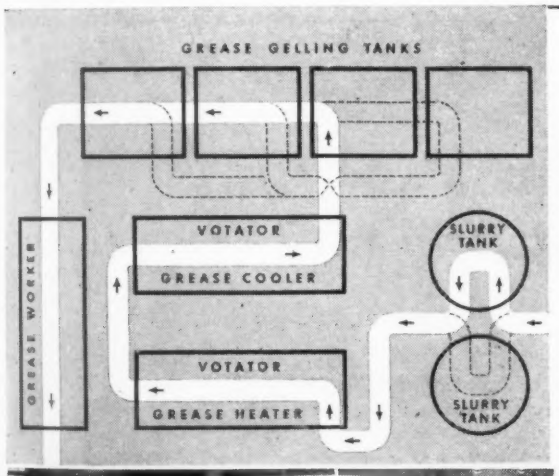

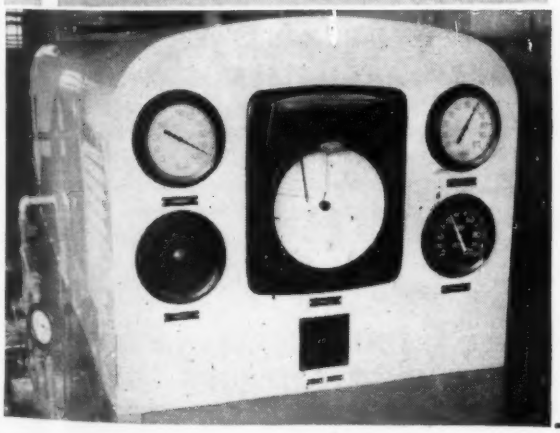

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Typical flow diagram of continuous, closed VOTATOR process, for aluminum stearate grease, and closeup of VOTATOR grease heater.

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bearing. We now use only selected high grade bearings from one manufacturer, and the variations are satisfactorily controlled.

The writer has purposely avoided detail description of the machines and technique employed in these two instruments as he wished to make two major points only; details can come later. One, absolute measurement of apparent viscosity is essential to any real knowledge of the behavior of greases; all the flow properties can be predicted and by no other means. Two, the adequate lubrication of a rolling bearing cannot be determined unless the bearing is under full rated load. The reason, we believe, is fairly obvious. When a rolling bearing is unloaded, rotation occurs freely without any distortion of balls, rollers or races. The contacts are nearest to the theoretical of point and line, since there is no load. Such an unloaded bearing may be lubricated with anything down to kerosene, and may even run dry successfully, provided bearing finish is good enough. But the load on a rolling bearing deforms both balls and races, so that it is perfectly evident that slip between them occurs. The Hertz equations show that loads at the area of contact are exceedingly high. Under these circumstances we should expect that a lubricant high in oiliness or E.P. effect, or both, would be required, and that viscosity would be important. Yet it has been said that any oil will lubricate a loaded rolling bearing and the soap is only there to act as a matrix to feed the oil in. We would like to see this one proved; the statement seems to us dangerously optimistic.

There has been, right along, a demand for cheaper test equipment, and of course quicker testing. In this laboratory alone there are 10 or 12 grease testing machines besides the two discussed herein, and we have no doubt that many other "children of the brain" are in use, so that there are perhaps 25 or 30 different machines to accomplish what not more than three designs could do. It would appear much more important to get test equipment that is right and gives absolute and complete data than that it should be cheap. It will be time enough to improve the apparatus for cheapness and speed after we have obtained correct absolute data.

The two machines generally described above are undoubtedly more expensive than the corresponding devices in use, but obviously the cost can be greatly reduced by redesign after the development model.

It looks as if the grease industry could get out of the highly empiric state in which it has existed hitherto and establish a rational basis for the make-up and use of greases. We should be glad to furnish detail information and discuss testing with anyone who is interested.

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NOTHER NEW FEATURE OR "THE SPOKESMAN"

It is a pleasure to announce the addi- on of a "TECHNICAL COMMITTEE OLUMN" in "The Institute Spokes- an." Starting January, 1948, each issue ill carry a special column devoted to e activities of the very important chnical Committee. These columns ill either be written by Chairman T. G. chner (Socony-Vacuum Laboratories, ooklyn, N. Y.) or one of his Vice airmen, Mr. H. L. Moir (The Pure l Company, Chicago, Ill.), Mr. Wil- m H. Oldacre (D. A. Stuart Oil Com- ny, Chicago, Ill.), or if authored by meone else will be edited by these three ntlemen.

This column will be used to make onth by month progress reports on the tivities of the Committee as for in- ance, "THE PUMPABILITY OF REASE AND DELIVERY CHARAC- ERISTICS OF DISPENSING EQUIP- ENT" which was the subject of the chnical Committee sympos'um at the t two Annual N. L. G. I. Conventions. will give the Committee an opportu- ty to inform the readers of "The okesman" on new projects undertaken, ch as the "ABEC-NLGI Cooperative mmittee on Grease Tests Methods." There will be information about new Technical Committee Bulletins in process and other information of equal interest and importance to the industry.

Those who have conceived the idea of this Technical Committee column visualize the possibility that it may grow into an open forum for the exchange of ideas and the discussion of important technical developments in the industry and for the expression of various points of view by the Technical Committee members during the interum between their meetings.

The Technical Committee, as you know, is the largest single Committee of the N. L. G. I., at the moment 99 members. The membership is made up of one or more representatives of each Company holding N. L. G. I. Membership, the appointments having been made jointly by the President of the N. L. G. I. and the Chairman of the Technical Committee. The purposes of the Committee are largely those of the Institute itself as outlined in Article 3 of the Constitution and By-Laws, as follows:

"The purposes of the Institute shall be to act as a clearing hou e for the collection and dissemination of lawful information pertinent to the manufacture and use of lubricating grease and to promote the following activities:

A. The development of product classification and methods of test through research, practical tests, and through cooperation with other technical societies; and the publication of such data for the use of consumers of grease and the grease manufacturing industry.
B. The study and development through research and technical procedure of improvements in the manufacture of lubricating grease, new uses, and the study of new consumer requirements.
C. The collection and dissemination of technical information, including improved manufacturing equipment, new uses and improved methods of application of lubricating greases, to members, consumers and industry in general.
D. The fostering of such industry policies as will tend to maintain free and open competition among manufacturers and all classes of trade who serve in distributing the products of the industry.

Watch for and read the Technical Committee columns in the January, 1948 issue of "The Institute Spokesman" and each subsequent issue from then on. Contributions to the column will be welcome, carefully edited and used if at all possible.

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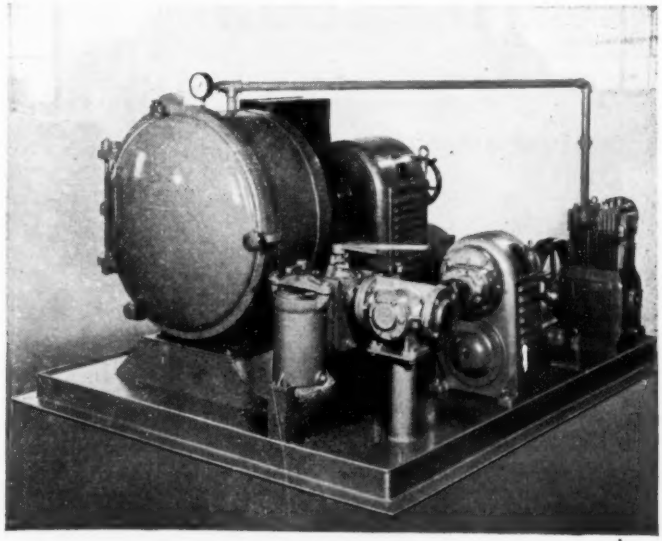

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MORE SIDELIGHTS OF A SUCCESSFUL CONVENTION

Mr. Keith J. Franshier, Petroleum Editor of the Chicago Journal of Commerce, arranged for a special section devoted to the N.L.G.I. Convention in both the Thursday and Friday papers, October 16th and 17th, when the Convention was being held at the Edgewater Beach Hotel in Chicago. In addition to a headline streamer across the top of the page which identified the section as the N.L.G.I. Convention section, the daily program was printed, there were special articles written by members in the Industry and advertisements to balance these.

Sufficient complimentary copies were provided so they could be placed under the doors of those staying at the Edgewater Beach in addition to those copies made available at the Convention session.

The N.L.G.I. was complimented to have the Chicago Journal of Commerce take this proper recognition of the 15th Annual Convention and those in attendance enjoyed receiving and reading the two complimentary issues.

The Registration Desk was efficiently handled by three attractive young ladi who have served the Institute in th capacity on previous years. Mrs. Mildre Davis of the Pure Oil Company, M Marie Frank of D. A. Stuart Oil Co pany, Ltd., and Miss Anne Paulson of t Deep Rock Oil Corporation, were loan by their respective employers during t three days of the Convention. The young ladies are not only efficient in th ability to handle the registration a collect the $1.00 registration fee, s banquet tickets and make a correct a counting of all the money, but al compiled a complete alphabetized list everyone in attendance and posted it the bulletin board so that by glanci over this list, you could determine w were registered at the Convention a where they were staying in case a meeti was desired. Not only did these you ladies handle the work at the Registrati Desk efficiently, but their manner w pleasing, they were most cooperative a made a visit to the Registration Desk pleasant experience. The Institute is i debted to Mr. W. G. Clark, Mr. W. Oldacre, and Mr. W. M. Murray f "lending" these young ladies to us aga

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President's Column . . .

J. R. Corbett
President N.L.G.I.

The start of a new year just naturally calls for an appraisal of the work that has been accomplished during the year that has ended. In this respect, I feel that all members of the N.L.G.I. can be justly proud. The year 1947 witnessed many progressive steps that contributed to the advancement of the Institute. We are all entitled to a feeling of satisfaction at what has been done.

But we must not make the mistake of resting on our laurels. There is entirely too much to be accomplished in 1948 to indulge ourselves in the luxury of remembering the past. We hope there will be plenty of time for remembering later on. But right now there is not a moment we can afford to waste.

Men of foresight have called 1948 a year of destiny. It could easily be just that. World-shaking events are happening with the rapidity of machine-gun fire. Indeed, there is so much happening so fast that we haven't time to weigh the importance of any one situation and evaluate it in its proper light until something even more astounding happens to command all our attention. This event, in turn, then loses consideration in the wake of something even more startling.

Just how does this affect us as members of the N.L.G.I.?

This is the way it *should* affect us. It should make each member realize that the Institute's work is more important now than ever before. Machinery is the mighty lord of the Atomic Age. And our work is with machinery. The Institute is, therefore, by the turn of world events forced into a position of prominence. Remember the lines: "Some are born great; others have greatness thrust upon them."

In many ways our work was hampered in 1947 by fluctuating markets and scarcity of materials. This situation will not be completely relieved in 1948, but it will, to a large extent, be ameliorated considerably. At least that's the way the picture looks at the present time. And that means that we should be able to make giant strides in 1948 toward accomplishing objectives that were heretofore completely unattainable.

I want to take this opportunity of wishing each member of the Institute a Happy New Year. I trust that 1948 will bring all of us even closer together in the great new work we are bound to accomplish.

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N.L.G.I. 16th Annual Convention Dates And Place Set

The Officers and the Board of Directors of the N.L.G.I. are delighted to be able to announce the date and place of the next (16th) Annual Convention.

Because Chicago, Illinois, is centrally located to the United States and Canada, is easily accessible by rail and air and because each succeeding Convention held in Chicago has had increased attendance, the decision was made to go to Chicago in 1948. The Edgewater Beach Hotel combines the essential facilities for taking care of a Convention of our size and kind, the meeting rooms have been adequate, the sleeping accommodations have been satisfactory, the well-trained staff of the hotel has given prompt and courteous service, plus a personal interest in the success of the Convention and the comforts of the N.L.G.I. members and their guests. The food has been satisfactory and therefore, the Edgewater Beach Hotel was designated. The dates are particularly attractive and you will want to mark them on your calendar. They are Monday, Tuesday and Wednesday, Oct. 11, 12 and 13, 1948. Reservations have already been made for single and double rooms, small and sun-parlor suites and family units to accommodate more people in anticipation of the larger attendance that we are hopeful of and sure to have.

Knowing that a great many of you will want to spend the week-end ahead of the convention in Chicago and as a special accommodation to the N.L.G.I. members and their guests attending the convention, arrangements have been made with the Edgewater Beach Hotel to accept 150 people on Saturday, October 9. This office will advise you from time to time through the year of the athletic events and entertainment features to be held in Chicago on October 9 and 10. Right now we can tell you that Northwestern University will play Minnesota University at Northwestern Saturday afternoon, October 9. It may not be too early even now to write for tickets. Undoubtedly, there will be a professional football game in Chicago on Sunday afternoon, October 10, while information about the theaters, concerts, art exhibits and other athletic events will be brought to you through these columns. The tentative program for the convention will be: Monday and Tuesday (October 11 and 12) morning and afternoon sessions: reading of Technical

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Papers (approximately 12 in number). Tuesday afternoon (October 12) Annual Business Meeting. Tuesday evening (October 12) Cocktail Party and Annual Banquet. Wednesday (October 13) morning and afternoon sessions, N.L.G.I. Technical Committee Meeting.

Mark these dates of October 11, 12 and 13, 1948, on your calendar. Make the necessary arrangements to come and let nothing interfere with your being in attendance when the N.L.G.I. 16th Annual Convention convenes at the Edgewater Beach Hotel in Chicago.

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